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Marshall Space Flight Center, Alabama 35812

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ORGANIZATIONAL WORK INSTRUCTION

**NONMETALLIC MATERIALS AND
PROCESSES GROUP/ED34**

STANDARD OPERATING PROCEDURE FOR HYDROBLAST OPERATION BASELINE

**CHECK THE MASTER LIST—
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1.0 SCOPE

- 1.1 Scope. This instruction describes the High Pressure Water Stripping and Cleaning processes. This process is conducted at the Hydroblast research cell in Building 4707 of the Productivity Enhancement Complex, Marshall Space Flight Center (MSFC).
- 1.2 Purpose. The purpose of this OWI is to establish the standard operating procedure for operating the hydroblast equipment.
- 1.3 Applicability. This OWI applies to the Nonmetallic Materials and Processes Group (ED34) of the Materials, Processes, and Manufacturing Division (ED30). ISO 9000 requirements apply to this instruction only to the extent that activities performed herein are "in-scope" as defined by the Marshall Management Manual.

2.0 APPLICABLE DOCUMENTS

- 2.1 MPG 1410.1 *Document and Data Control for Organizational Issuance*

3.0 DEFINITIONS

- 3.1 Hydrolaser. High pressure water stream emitting system used to direct water jet at article to be stripped or cleaned.

4.0 INSTRUCTIONS

- 4.1 General System Description.
 - 4.1.1 The high pressure water cleaning and stripping processes will be performed using the following major equipment:
 - 4.1.1.1 Pentium computer to control pumps, turntable, diversion valve switching, robot interface and monitoring of

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critical process operating parameters.

- 4.1.1.2 Pentium computer that supports the Fanuc Robot with terminal simulation and off line programming.
- 4.1.1.3 Fanuc Robot (S-420) for precision manipulation of the various nozzles used with the high pressure water spray systems.
- 4.1.1.4 12' turntable to position and rotate test panels, blocks, beams or structures for complete stripping coverage.
- 4.1.1.5 4' turntable to position and rotate subscale rocket motor segments.
- 4.1.1.6 Flow meters to measure water flow rate.
- 4.1.1.7 Thermocouples for monitoring water temperature.
- 4.1.1.8 Various valves, solenoids, and actuators that control air and water.
- 4.1.1.9 High pressure Hammelmann pumps to generate high water pressure.
- 4.1.1.11 Auxiliary Hydraulic pump to provide diversion valve switching and external hydraulic drive for the rotary nozzles.
- 4.1.1.12 Allen Bradley frequency drive system to provide a full range of operating speeds for the high pressure water pumps.
- 4.1.1.13 The cell also contains an exhaust system that removes water vapor from the hydroblast cell during and

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immediately following stripping and cleaning processes.

4.1.2 The hydroblast process normally follows the following sequential processing steps.

4.1.2.1 Article preparation

4.1.2.2 System configuration and startup

4.1.2.3 Cleaning and stripping of article

4.1.2.4 System shutdown

4.1.2.5 Post system operation cleaning

4.2 Calibration. Operator shall verify that any equipment or instrumentation requiring calibration is properly calibrated.

4.3 Prerequisites.

4.3.1 Operators shall be informed of the nature of and safety considerations for the materials handled during the operation.

4.3.2 Personnel shall verify safety equipment with lead technician or engineer during the prestart checklist.

4.4 Prestart Checklist.

Verify the following items prior to the startup of hydroblast system. In the case of some anomaly contact the lead engineer and proceed further only upon approval. Mark appropriately on Appendix A. Appendix A shall become a quality record.

4.4.1 Check and set the position of the manual diversion valve handles, on the second floor of the control room.

4.4.2 Check for proper oil level in the Hammelmann pump gear case.

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- 4.4.3 Verify that the robot water protection fan switch is ON.
- 4.4.4 Verify that the proper nozzle end effector is installed on the robot with the proper nozzle configuration.
- 4.4.5 Insure that all pump room lighting is on.
- 4.4.6 Turn on all available high intensity quartz lighting in the hydroblast spray room.
- 4.4.7 Ensure that the sump pump disconnect handle is in the ON position.
- 4.4.8 Visually check hydroblasting cell to ensure that it is clear of personnel prior to commencing blasting

4.5 System Startup.

- 4.5.1 Move the Allen-Bradley Frequency Drive disconnect handle to the ON position. (Located outside the east wall of the hydroblast pump room wall.)
- 4.5.2 OPEN the water supply valve for the 36K system operation. (Located above the 36K pump on the South pump room wall.) (Leave closed for the 20K pump operation).
- 4.5.3 OPEN the manual air valve to supply shop air to the 36K pump regulatory assembly. Adjust to a minimum of 4 Bar (60 psi). (Located above the 36K pump.) (leave closed for the 20K pump operation.)
- 4.5.4 Select either the 20K or 36K pump at the Pedestal Stand.
- 4.5.5 Turn the Ready switch to READY, hold momentarily and release to the ON position at the Pedestal Stand.

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- 4.5.6 Press the green START button and hold for several seconds at the pump pedestal stand. A high pitched two tone indicator will signal the energization of the pump.
- 4.5.7 Press the LOC/REM button on the key pad of the pump pedestal stand. (This toggles the pump control between LOCal and REMote operation.)
- 4.5.8 Turn the Hydrolaser Control Console computer main power switch ON.
- 4.5.9 Push Pump Auto switch ON, if running the system in the AUTO MODE. (Leave switch OFF, if running the pump manually).
- 4.5.10 If it is necessary to operate the turntable, push Turntable Air switch ON. (Leave button off if turntable is properly positioned and does not need to be operated.)
- 4.5.11 Push Turntable Auto switch On, if computer control of turntable is desired. (Leave switch OFF, if control of the turntable is to be done manually).
- 4.5.12 Push the three Diversion valve switches to desired position open or closed depending upon which nozzle is desired to be used if the 20K pump has been selected. Push all three valve switches to the closed position if the 36K pump has been selected.
- 4.5.13 Press the ON button on the RJ Controller for the Fanuc robot.
- 4.5.14 Release the Emergency Stops located on the RJ controller panel and on the teach pendant.
- 4.5.15 Press the Fault Reset button on the RJ controller panel.
- 4.5.16 Verify that the correct program and floppy disk are selected and that proper clearances are maintained for this operation.

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- 4.5.17 Type the word "HYDRO" at the DOS prompt on the pentium controller computer and then press the ENTER key.
- 4.5.18 Select the command PSI water pressure field and enter the desired value for this operation.
- 4.5.19 Turn the booster pump switch ON.
- 4.5.20 Turn the switch for the diversion valve hydraulic pump to the ON position.

4.6 System Operation.

- 4.6.1 Visually check hydroblasting cell to ensure that it is clear of personnel prior to commencing blasting.
- 4.6.2 Enable the pump drive from the controller computer if operating in the auto pump mode. Turn the pump drive potentiometer clockwise otherwise to bring the pressure to at least operation at 20% rated capacity of the pump.
- 4.6.3 Allow the pump to operate at idle for a couple of minutes to allow the pump to warm up before placing it in stress.
- 4.6.4 Select the NORMAL mode of pump operation from the controller computer and allow the pump to stabilize at the commanded pressure if operating in the pump auto mode. Otherwise, turn the pump drive potentiometer clockwise until the desired pressure has been achieved.
- 4.6.5 Press the Cycle start on the RJ Controller and monitor the process for any and all anomalies.
- 4.6.6 Operator shall perform a visual inspection of the hardware to verify that the component has been cleaned or stripped satisfactorily. When the cleanliness level is considered satisfactory, press the User Push button # 1 during the cycle to signal the robot that this will be the last pass over the article.

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4.6.7 Disable the pump for a close visual inspection of the article.

4.6.8 If the article is not considered satisfactorily stripped after a close visual inspection, return to step 4.6.3.

4.7 System Shutdown.

4.7.1 Disable the pump at the controller computer.

4.7.2 Push the F1 key on the controller computer keyboard.

4.7.3 Push Pump Auto switch OFF, if the system was operated in the AUTO MODE.

4.7.4 Turn booster pump switch to OFF.

4.7.5 Move the diversion valve switch to the OFF position.

4.7.6 Place the robot into a "Safe Condition", by depressing one of the Emergency Stop buttons on either the teach pendant or the RJ Controller main panel.

4.7.7 Press the OFF button on the RJ Controller for the Fanuc robot.

4.7.8 Push the three Diversion valve switches to OPEN position.

4.7.9 CLOSE the manual air valve to supply shop air to the 36K pump regulatory assembly.

4.7.10 Press the LOC/REM button on the key pad of the pump pedestal stand. (This toggles the pump control between LOCal and REMote operation.)

4.7.11 Press the red STOP button at the pump pedestal stand

4.7.12 Turn the Ready switch to the OFF position at the Pedestal Stand.

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- 4.7.13 Turn the pump select switch to the neutral position.
- 4.7.14 CLOSE the water supply valve for the 36K system operation. (Located above the 36K pump on the South pump room wall.)
- 4.7.15 Move the Allen-Bradley Frequency Drive disconnect handle to the OFF position. (Located outside the east wall of the hydroblast pump room wall.)
- 4.7.16 Push Turntable Auto switch OFF, if computer control of turntable was exercised.
- 4.7.17 If it was necessary to operate the turntable, push Turntable Air switch OFF.
- 4.7.18 Turn the Hydrolaser Control Console computer main power switch OFF.
- 4.7.19 Turn the Warning Lights OFF.
- 4.7.20 Turn off the high intensity quartz lights.
- 4.7.21 Remove the cleaned hardware or articles from the cell.
- 4.7.22 Operator shall fill out Appendix B, Shutdown Checklist. Appendix B shall become a quality record.

4.8 Post System Operation Cleaning.

- 4.8.1 Wash down the cell.

5.0 NOTES

NONE

6.0 SAFETY PRECAUTIONS AND WARNING NOTES

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- 6.1 Work occurring in the hydroblast facility shall adhere to standard facility safety practices and requirements.
- 6.2 Proper personal protective equipment shall be worn before, during, and following a cleaning or stripping process.
- 6.3 All personnel involved in the spray process should be familiar with the MSDS's and disposal procedure.
- 6.4 Visually check the hydroblast cell to ensure that it is clear of personnel before commencing blasting and prior to restarting the pump after momentary shutdowns.
- 6.5 The door to the cell is locked during all operation but a panic bar allows emergency egress from inside the cell. The back and side doors to the pump room are locked during all operation but the side door has a panic bar to allow emergency egress from inside the cell and the back door can be opened from inside the pump room.
- 6.6 A rotating red light is illuminated automatically by the computer system during all operations.
- 6.7 Consult MSFC Safety for any safety related concern.

7.0 DATA, REPORTS, AND FORMS

- 7.1 This procedure shall be revised to include any changes to the system configuration hardware or software.
- 7.2 The Work Order Request Form shall be properly and completely filled out and approved before starting any work.
- 7.3 The effectiveness of this process will be reviewed bi-annually with supervisor during performance planning, mid-term progress review and appraisal. This performance planning and evaluation will be maintained as a quality record.

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7.4 Process owner will coordinate with ED34's applicable ISO9000 document custodian to ensure that the latest proper document revision is maintained.

8.0 QUALITY RECORDS

Quality records for this system will be maintained for all in-scope work by ED34 for the duration of the project plus three years. If the operation is part of an in-scope project, the operator is responsible for completing the following list:

- Make two (2) copies of each of the following:
Appendix A: Startup Checklist
Appendix B: Shutdown Checklist
- Give one copy to the lead engineer for the in-scope project
- Give the second copy to the applicable ED34 Management Support Assistant (Building 4712, Room B206)
- Return the original to the User's Log Book located in the hydroblast control room
- Blank copies of the checklists are to be printed out from the computer in the hydroblast control room. The file containing the checklists is kept on the D: drive in the Hydroblast Documents subdirectory and is called Hydroblast Checklists.doc

Training Records, Certification/Authorization Lists, and Calibration Lists associated with in-scope work will also be maintained by ED34. Training and Certification records will be maintained as long as the employee is performing in-scope work. Calibration records will be maintained and replaced only with current information.

All Quality Records, if applicable, will be maintained by ED34.

9.0 APPENDICES

9.1 Appendix A Prestart Checklist

9.2 Appendix B Shutdown Checklist

9.3 Appendix C Work Order Request Form

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10.0 TOOLS, EQUIPMENT, AND MATERIALS

10.1 Tools and special equipment are stored in the pump room.

11.0 PERSONNEL TRAINING AND CERTIFICATION

Any personnel using this system to perform in-scope work must be authorized by ED34. A list of qualified users is maintained by ED34. The requirements for qualification are listed below. Authorization will be given by the ED34 hydroblast system lead engineer after completion of all training requirements.

An informal class conducted by the ED34 hydroblast system lead engineer shall be given to all prospective operators to explain the operational requirements of the system and all safety issues which must be observed during operation. The class will include a walk through of the facility to familiarize students with the equipment discussed in the class.

On the Job Training (OJT) for a minimum of four startup to shutdown operations. Additional OJT may be required until the trainee demonstrates safe and proficient operation of the equipment, and understanding of the proper safety procedures. The training may be performed only by the ED34 hydroblast system lead engineer or designee.

The qualification period for using this system will be four years. However, if the operator has not safely operated the equipment at least two times each month, the operator's authorization may be revoked. Preceding the expiration of their authorized operational period, the operator may qualify for reauthorization dependent upon the approval of the ED34 hydroblast system lead engineer.

For all authorized contractor employees, ED34 must have on file, a memo from the employee's supervisor stating that the employee has been selected to work as an operator of this equipment. Once the memo has been received by ED34, approval will be given and a class scheduled.

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Careless or unsafe operation of this system may result in the revocation of the operator's authorization.

Personnel shall be retrained when any system configuration changes are made to the hardware or software.

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Appendix A
Prestart Checklist

OPERATION	OPERATOR NAME	DATE
Check and set the position of the manual diversion valve handles, on the second floor of the control room.		
Check for proper oil level in the Hammelmann pump gear case.		
Verify that the robot water protection fan switch is ON.		
Verify that the proper nozzle end effector is installed on the robot with the proper nozzle configuration.		
Ensure that all pump room lighting is on.		
Turn on all available high intensity quartz lighting in the hydroblast spray room.		
Ensure that the sump pump disconnect handle is in the ON position.		
Visually check the hydroblast cell to ensure that it is clear of personnel before commencing blasting.		

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Appendix B
Shutdown Checklist

OPERATION	OPERATOR NAME	DATE
Turn booster pump switch to OFF.		
Move the diversion valve switch to the OFF position.		
CLOSE the water supply valve for the 36K system operation. (Located above the 36K pump on the South pump room wall.)		
Move the Allen-Bradley Frequency Drive disconnect handle to the OFF position. (Located outside the east wall of the hydroblast pump room wall.)		
Turn the Hydrolaser Control Console computer main power switch OFF.		
Turn the Warning Lights OFF.		

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WOR#_____

Hydroblast Work Order Request Form

Object to be stripped: _____

Material to be stripped: _____

Quantity to be stripped: _____ Need Date: _____

Calibration required: ☐ Yes ☐ No ISO9000 Documentation required: ☐ Yes ☐ No

Project: _____ NASA Charge Code: _____

Requested by: _____ Date: _____

Special Instructions: _____

Request submitted by: _____ Date: _____

NASA liaison

Approved by: _____ Date: _____

ED34 System Lead Engineer

Start Date/Time: _____ End Date/Time: _____

Work completed by: _____ Date: _____

ED34 Operator